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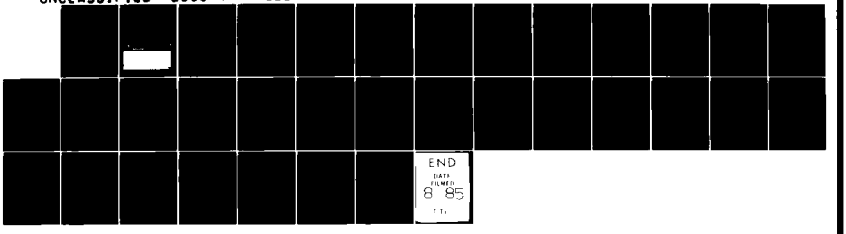

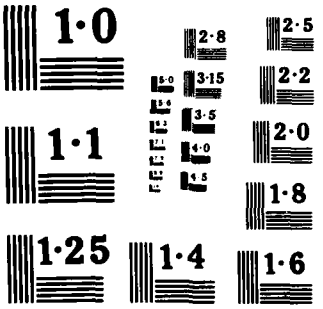
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TASK 1 LETTER REPORT

VAMOSC
ADPE SUPPORT CONSIDERATIONS

March 1984

Prepared for
HEADQUARTERS AIR FORCE LOGISTICS COMMAND
MML (VAMOSC)
WRIGHT-PATTERSON AFB, OHIO
under Contract F41608-82-D-A012-0005

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by

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The above statement can be deleted per Mr. Donald J. Romie, HQ AFLC/MML (VAMOSC)

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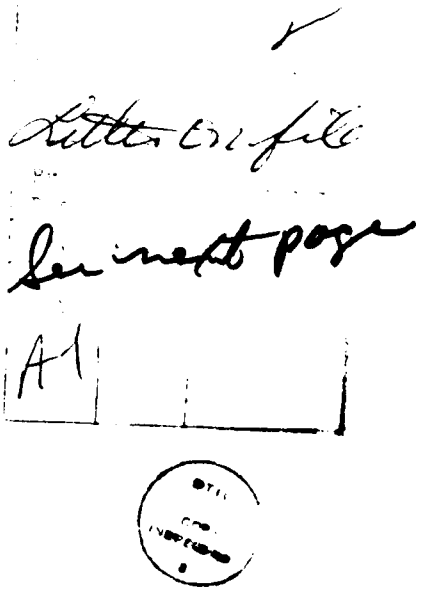

ABSTRACT

This letter report, which describes the results of Task 1 activity, is submitted in accordance with Contract Data Requirements List (CDRL) Sequence Number A002 of Contract F41608-82-D-A012-0005. The report documents the first phase in recommending a cost-effective technology that will support the data requirements of the U.S. Air Force Visibility and Management of Operating and Support Costs (VAMOSC) for the 1990s and beyond. Such a technology will allow VAMOSC to become more timely in its response to the needs of VAMOSC users as processing demands are imposed by future growth. Task 1 consisted of identifying the current and future data requirements. The period of performance for this task was 1 October 1983 to 1 March 1984.

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CHAPTER ONE

INTRODUCTION

The U.S. Air Force Visibility and Management of Operating and Support Costs (VAMOSC) Program Office is responsible for the development of the Air Force VAMOSC data systems. VAMOSC currently consists of three data systems that collect and report the operating and support (O&S) costs for USAF aircraft at the mission/design/series level, components of aircraft systems at the work unit code level, and ground communications-electronics systems at the type/model/series level. The three data systems are: Weapon System Support Cost (WSSC), Component Support Cost System (CSCS), and Ground Communications-Electronics (C-E). These systems have been developed to meet Air Force and Department of Defense (DoD) requirements.

The Air Force has several uses for VAMOSC data, including (1) to support planning and budgetary input to the Defense System Acquisition Review Council (DSARC) process for acquisition of new weapons systems, and (2) to aid the Program Objective Memorandum (POM) process to identify existing systems for possible modification. VAMOSC data provide the manager of Air Force weapons systems with the visibility of the resources required to support those systems. The data also provide a means by which the trends of Air Force weapon system O&S costs may be developed.

1.1 STATEMENT OF THE PROBLEM

VAMOSC, a dynamic program under the direction of DoD, is designed to manage O&S costs. To meet future needs, the VAMOSC Program Office has realized the necessity for planning the transition of its current batch-oriented automated data processing equipment (ADPE) posture to one that supports the data requirements of the 1990s. The technology selected must handle the processing and archival demands of a historical data base with the capacity of storing up to 10 years' worth of data.

The Air Force recognized these needs and contracted with ARINC Research Corporation to accomplish the following tasks to provide alternative capabilities and increase the utility of VAMOSC:

- Task 1 - Identify the output data requirements by quantifying annual VAMOSC data production through 1995 and by categorizing data types by their access requirements and frequency of reuse.

- Task 2 - Identify and evaluate alternative technology approaches to processing and storing VAMOSC-produced data.

In addition, the Air Force has contracted with ARINC Research Corporation to identify the training requirements and develop a training plan for the VAMOSC system. This letter report presents the results of Task 1; the results of Task 2 and the VAMOSC Program Training Plan will be presented as separate reports.

1.2 TASK OBJECTIVE AND ORGANIZATION

The objective of Task 1 is to identify the current and future data requirements imposed on the VAMOSC system. The data requirements will drive the evaluation of alternative technologies that will process and store VAMOSC-produced data. We employed two techniques to obtain the desired information: (1) a survey of the current and potential VAMOSC user community, and (2) measurement of the current VAMOSC data systems.

We conducted surveys* of cost analysts to help identify future data requirements that will be placed on the VAMOSC system by the user community as well as responses that represent the majority of the users interviewed. During the course of interviewing, many user views concerning areas for VAMOSC data improvement surfaced. These suggestions are summarized in this report (Section 2.1.3.1) and represent the analysts' current perception of the VAMOSC systems.

We also assessed the current data system outputs, evaluating the number of magnetic tape files required to support processing, storage requirements for the magnetic tape files, and the output products produced for each of the three VAMOSC subsystems (WSSC, CSCS, and C-E). Assessment of these outputs will provide an initial understanding of and input to the Task 2 effort. Additional analysis of the VAMOSC computer system functions, coupled with the current sizing requirements, will provide a platform from which future sizing requirements can be determined.

The successful accomplishment of the Task 1 objectives was predicated on two assumptions: (1) an informed VAMOSC user public and (2) a VAMOSC data processing system with a measurable performance history. However, we found that neither of these necessary conditions were in place when we began our user survey in October 1983. As a result, the data from the Task 1 effort were not enough to quantify, categorize, and project VAMOSC data requirements into the 1990s. Further work will be required in Task 2 to supplement the results of Task 1 to achieve the desired Task 1 objectives. These supplemental data will be presented in a final report as part of the Task 2 effort.

*The term "survey" is used to describe an interview process that is standard practice in data system sizing analysis. It should not be assumed that either statistical analysis or polling techniques were applied; only user requirement definitions were sought. To ensure consistency during each interview, a user survey/interview form was developed (see Appendix A).

CHAPTER TWO

USER SURVEY AND OUTPUT EVALUATIONS

2.1 USER SURVEY

To establish an understanding of the requirements and problems of the Air Force cost analysts who are current or potential VAMOSC users, and to help categorize and quantify future system workloads, ARINC Research conducted a survey of cost analysts. We had hoped that the majority of the analysts interviewed would be current VAMOSC users who could cite specified usage requirements. However, this type of interview proved to be the exception, because few cost analysts admitted to using or trusting VAMOSC data. The primary problem stemmed from the lack of data in the VAMOSC subsystems. For example, the most mature subsystem, WSSC, only had two years' worth of data. Thus, answers to our questions centered on the data currently used to analyze weapon systems and C-E equipment.

ARINC Research personnel traveled to the user sites to conduct the interviews. Appendix B lists the people interviewed. The person-to-person interview allowed the analyst to express his or her perception of needs and avoided the problem of obtaining a standard set of responses. A questionnaire, presented in Appendix A, was developed to ensure consistent and uniform coverage of topics. If questions arose concerning interpretation of user comments, a follow-up interview was conducted by telephone.

The areas examined during the survey included data required to conduct a cost analysis, current data sources, frequency of data reuse, response time associated with the acquisition of data, historical range of data required to conduct a cost analysis, type of medium on which data are received, and the general awareness of VAMOSC. The last area was important in determining the relative value of each response.

2.1.1 User Assessment

Three types of users were identified:

- Current users - Cost analysts who have used VAMOSC data to support O&S cost analyses

- Potential users - Cost analysts who have not yet used VAMOSC data but are currently investigating its feasibility and validity

- Future users - Cost analysts who will use VAMOSC data when the system achieves more "maturity"*

Table 2-1 groups the offices interviewed into the three user types. The table depicts an organization's usage, not individual usages. The actual breakdown of users surveyed is: current users, 18 percent; potential users, 36 percent; and future users, 46 percent.

We found that numerous organizations were using data systems other than VAMOSC. Several of these other systems are feeder systems into VAMOSC. To relate this information to VAMOSC, we grouped the users' responses according to the VAMOSC subsystem applicable to the type of cost analysis performed. Table 2-2 presents the results and identifies those data systems which are feeders to the VAMOSC subsystems. We found that a sizable number of users rely on personal contact with the bases, System Program Offices (SPOs), or Major Commands (MAJCOMs) for obtaining cost data.

2.1.2 Potential Requirements

We questioned cost analysts about the requirements that must be met for VAMOSC to be considered a credible system. The answers will be used to project the number of future data automation requirements (DARs) and to assess the impact on processing and storage requirements.

Most of the responses given during the interviews seemed to be hypothetical, because most of the people interviewed did not have an extensive knowledge of VAMOSC products. However, current users were able to give more detailed indications of their requirements. We segregated requirements into four general categories: potential generic requirements, potential WSSC requirements, potential C-E requirements, and potential CSCS requirements. These categories are described in the following subsections.

2.1.2.1 Potential Generic Requirements

We questioned each user about his or her general usage requirements. The following system characteristics were identified as being generic to all three VAMOSC subsystems:

- Historical range of data
- Age of data
- Frequency of data reuse

*"Maturity" means different things to different system experts, but it is generally accepted to mean validated data bases and algorithms as well as adequate data volumes and sources.

TABLE 2-1

USER ASSESSMENT

Current Users	Potential Users	Future Users
AFWAL/FIA (WSSC, C-E, CSCS)	Boeing Aerospace Co. (WSSC, CSCS)	AFAFC/CWM
Grumman Aerospace Corp. (WSSC, C-E, CSCS)	Lockheed California Co. (WSSC, CSCS)	HQ USAF/ACMC
SM-ALC/MMCRACA (C-E)	Northrop Corp. (WSSC, CSCS)	HQ USAF/LEYE*
OC-ALC (WUC/NSN of CSCS)	OSD/PA&E (WSSC, C-E, CSCS)	AFCC/LG*
AFLC/ACMC (WUC/NSN of CSCS)		AFSC/ALPA
AFLC/ACMC (WUC/NSN of CSCS)		ASD/YPLI
ARINC Research Corp. (CSCS)		HQ MAC/LG
Information Spectrum, Inc. (WSSC, CSCS)		SM-ALC/MMC*
		Rockwell International Corporation

*Currently using LME Corporation's C-E logistics support cost (LSC) report.

- Response time
- Output product medium

The following paragraphs summarize the most common responses.

The first system characteristic, the number of years of historical data required to perform an analysis, received a wide range of responses. The most common response for the minimum years of historical data needed was 5 years; the most common response for the maximum years of historical data needed was 10 years. These responses defined the average range of historical data required to do the job. However, HQ AFLC/ACMC and AFAFC/CMW expressed their need for as much data as possible (life of the system).

TABLE 2-2

DATA SYSTEMS CURRENTLY USED

WSSC	CSCS	C-E
G033*	D041	D039*
H036*	D056*	D041*
H058	H036*	D056*
General Accounting and Finance Systems	Contractor-Supplied Data	G019
Maintenance Cost System	Telephone Calls to Bases, SPOs, MAJCOMs	H036*
AFM 26-3		Equipment Status Report
AFR 173-13		Material/Quality Deficiency Report
		LME's LSC Report
		Tri-Service Data
		Contractor-Supplied Data
		Telephone Calls to Bases, SPOs, MAJCOMs

*VAMOSC feeder system.

Another system characteristic of concern was the age of data once data become available in a VAMOSC report. Users do not seem to be concerned with the fact that data are often more than six months old, as in the WSSC and C-E subsystems. Most users are aware of processing limitations and are willing to wait for fiscal year-end data (which may be as much as one and one-half years old).

A driving factor in access requirements is the frequency of data reuse. The need to request a new set of report data (for a different system or component) averaged two to three times per month. This represents the

number of new project starts or at least a change in direction. Once the report data (either VAMOSC or other currently used data) were obtained, they were accessed approximately once per week. Respondents indicated that these estimates were conservative.

The most critical requirement was response time -- the time it takes to receive information once it is requested by the user. Currently, the average user receives requested reports within one month. Some analysts had requested VAMOSC documentation that had never been received. A large portion of analysts are involved in ongoing projects in which the receipt of report data supported by a distribution list serves their needs. There were instances when a rapid response of one day was required, but the most common requirement was that data be received within a week.

Currently, users are receiving reports on microfiche or paper. These types of output product media will continue to fill a need within the user community in the future. However, a large portion of users expressed a requirement for magnetic tape data files that can be manipulated at their facility.

Table 2-3 summarizes the potential generic requirements and presents the range of answers received.

2.1.2.2 Potential WSSC Requirements

The following paragraphs summarize the requirements of WSSC subsystem users.

Some confusion exists between the Aircraft Operating and Support Costs Report (Cost Analysis Improvement Group [CAIG] format) and the Aircraft Operating and Support Costs - USAF Detail Report. Many users like the more detailed breakout of the USAF Detail Report, but the documentation of AFR 400-31 does not easily explain the differences between the two reports. It is possible that an individual could use CAIG data to verify a cost analysis compiled from USAF detail data and obtain conflicting results.

Most cost analysts conducting top-down analyses for weapons systems felt they would like to be able to separate costs easily by two-digit work unit codes; they expressed a requirement for this capability to be available in WSSC.

A general requirement described by many users of weapon system data was to establish consistent data definitions between VAMOSC and the data systems that VAMOSC is targeted to replace. As described by AFAFC/CWM, the calculation of AFR 171-13 cost factors requires that data be consistent between current data sources/data methodology and VAMOSC; VAMOSC cannot be accepted until those definitions agree.

Special breakouts of costs are also required. Many cost analysts required that expenditures be separated by element of expense investment code (EEIC) -- in particular, general support and system support. Base

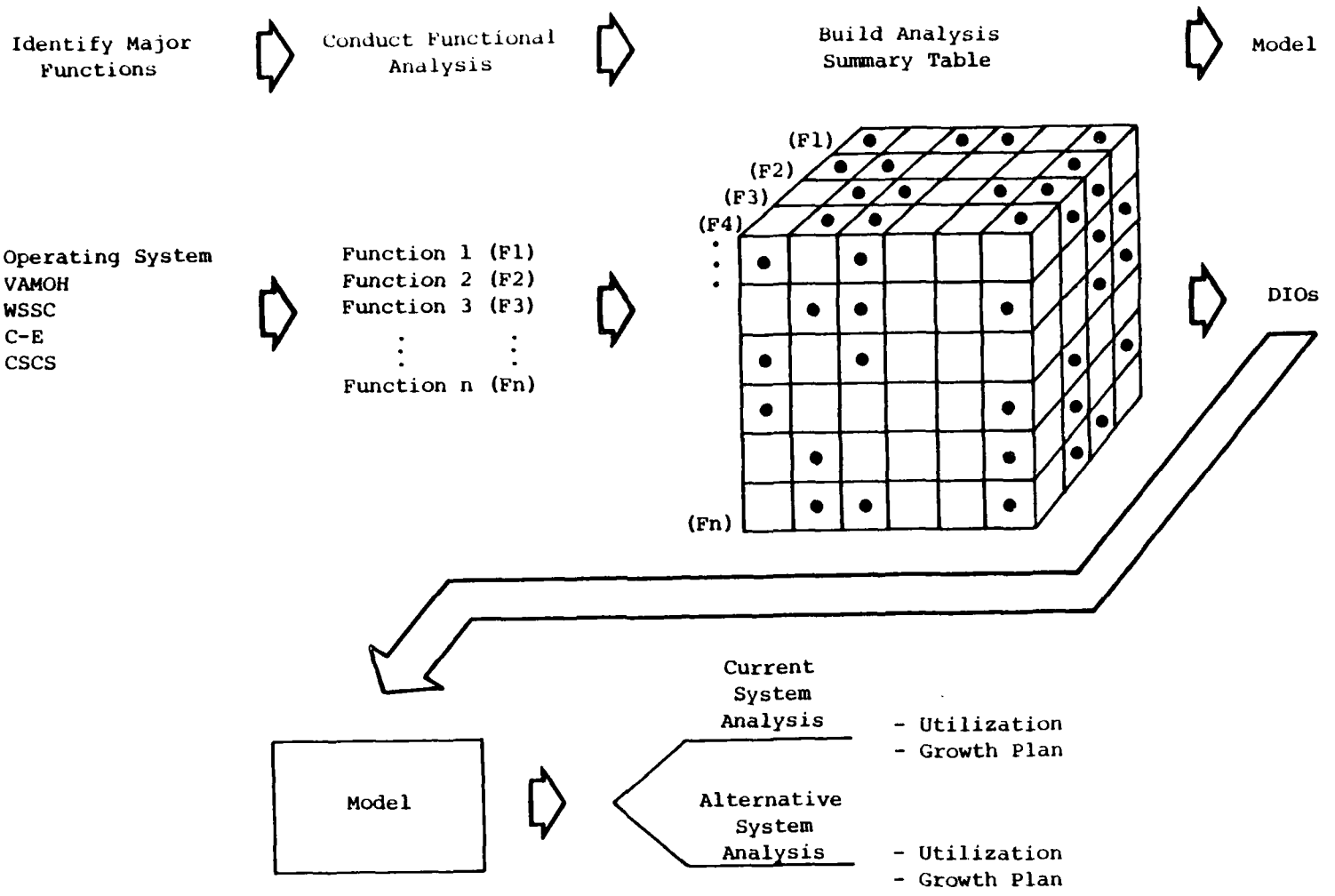

FIGURE 3-1

BUILDING THE DIO MODEL

CHAPTER THREE

TASK 2 EFFORT

This report has presented the results of our efforts in Task 1. In Task 2 we will identify and evaluate alternative technology solutions that will satisfy the processing and storage requirements imposed by the VAMOSC system. To do this, we will develop a model to estimate the percentage of computer resource utilization at peak workloads by performing a functional processing load analysis. A functional processing load can be described as a workload that would result from the execution of a computer program or routine that causes data to pass back and forth between the CPU memory and auxiliary storage. This data transfer can be expressed in physical disk inputs and outputs (DIOs). To determine the number of DIOs required for processing, we will identify four (VAMOH, WSSC, C-E, and CSCS) processing functions, perform a functional processing analysis to obtain the number of DIOs per function, group the functions required to do the job and sum the DIOs, and apply the function reuse factors (e.g., is the function used once, or is it reused 10 times during the process?). An algorithmic relationship (model) may then be developed to illustrate what effects changes in projected computer workloads will have on computer resource utilization. Figure 3-1 illustrates the steps involved in building the model.

Once the model has been developed, a list of ADPE selection criteria will be established. Finally, the alternative ADPE configurations will be selected and ranked.

Several areas are topics of concern. The audit trail of VAMOSC system changes, data element changes, and program library changes must be maintained, yet maintenance of such an audit trail is difficult and laborious.

The capture of LME Corporation's C-E data also causes concern. VAMOSC's C-E subsystem will replace the LME system. However, the LME system is written in a language that is not compatible with VAMOSC. The transition of LME's history data is important in providing VAMOSC a larger historical data base.

VAMOSC's primary goal is to provide the user with accurate O&S cost data in a timely manner. As VAMOSC matures, management of annual (and quarterly) computer processing becomes a minor problem in comparison to the maintenance and management of the historical data base archive (at least 10 years). So far, the data base archive problems have been minimal, since the VAMOSC subsystems are relatively new data systems. However, VAMOSC's projected growth rate and increased data base archive responsibility dictate that more management attention must be focused on (1) planning for the expansion of the existing computer resources, (2) planning for the computer data base archival storage needs that will continue to become a larger issue as VAMOSC continues to mature, and (3) planning for the expansion of the VAMOSC system into its own computer resource facility with its own computer support organization.

TABLE 2-4

VAMOSC INTEGRATED DATA BASE PRELIMINARY SIZING ESTIMATES

Subsystems and Tables	Current Size* (FY 1981 and 1982)	Growth Cost Factor Calculation	Five-Year Estimated Size (Current Plus Growth)
WSSC	0.4 Mbyte	$\frac{0.4 \text{ Mbyte}}{2 \text{ years}} = \frac{0.2 \text{ Mbyte}}{\text{year}}$ $\frac{0.2 \text{ Mbyte}}{\text{year}} \times 3 \text{ years} = 0.6 \text{ Mbyte}$	1.0 Mybte
C-E	11.0 Mbytes (EX tape)	$\frac{11 \text{ Mbytes}}{2 \text{ years}} = \frac{5.5 \text{ Mbytes}}{\text{year}}$ $\frac{5.5 \text{ Mbytes}}{\text{year}} \times 3 \text{ years} = 16.5 \text{ Mbytes}$	27.5 Mbytes
CSCS	236.0 Mbytes (7 dumptape reels)	$\frac{236 \text{ Mbytes}}{2 \text{ years}} = \frac{118 \text{ Mbytes}}{\text{year}}$ $\frac{118 \text{ Mbytes}}{\text{year}} \times 3 \text{ years} = 354 \text{ Mbytes}$	590.0 Mbytes
Common Tables and Factors	691.0 Mbytes includes: - C-E AR tape - C-E AX tape - 13 single-record CSCS tapes	Size of tables and factors should remain fairly static	691.0 Mbytes
Total	938.4 Mbytes		1,309.5 Mbytes

*Sizes are approximations.

Most of the users felt that an interactive terminal connect capability for VAMOSC data base on-line query was not essential for meeting their needs. However, they were interested in quick turnaround time. Quicker service for ad hoc requests could be provided if the VAMOSC subsystems were available for interactive query and manipulation from the VAMOSC Program Office. Many of the cost analysts had access to some type of computer resource and expressed their desire to have data delivered in the form of magnetic tape.

- A growth factor could be calculated based on available magnetic tape file data (sizes, in bytes, were rounded to the nearest million where applicable).

- At least five years' worth of history will be maintained in the on-line data base (since the current data base processed two fiscal years of data, a three-year multiplier was used in conjunction with the results of the growth factor).

- One copy of tables and cost factors will service the three VAMOSC subsystems (we chose to combine C-E and CSCS tables for this size, since CSCS was the largest and C-E was the most unique).

- Eight data bits equal one data byte equal one data character (this is mentioned since it differs from the CYBER environment on which VAMOSC operates, e.g., 10 data bits equal one data character).

Table 2-4 illustrates the results of our preliminary integrated data base sizing analysis. As can be seen from the table, more than 1 billion bytes of data will be required to maintain a five-year on-line data base history. In the current VAMOSC data processing environment, using the CYBER Model 844 disk drive (capacity 143 Mbytes), 10 drives would be required to maintain this data base on-line (this figure does not include those drives required to support the operating system, working files, system utilities, and application program libraries).

2.4 SUMMARY

The cost analysts we interviewed universally agreed that there is a need for VAMOSC. They were aware of the obstacles the VAMOSC Program Office had to overcome and will continue to face, and were pleased with the progress VAMOSC had made. However, the analysts felt that VAMOSC needs time to mature. They look forward to having most of the data base processing "bugs" under control, more available data base history, better quality of data, and a more flexible ad hoc inquiry process. The analysts hope that, in time, these features will be integrated into the system.

The cost analysts want to be more involved in the evolution of VAMOSC. They want individualized training, through which they can become familiar with general definitions of the elements and reports most applicable to their costing needs. They want continued feedback of changes to the VAMOSC system, and they want VAMOSC to react to their suggestions for improvement.

Interaction with the feeder system representatives must be continuous. Any changes to the data collection and reporting must be known. Possible changes to data system interfaces must also be tracked. Hence, it may be prudent to establish close working relationships with VAMOSC feeder system representatives.

To archive this processed information, CSCS maintains 16 magnetic tape files in dumptape format. Thirteen of these tape files store a single type of record, and the other three store more than one type of record. Of the three tape files that store more than one type of record, two require three 3,600-foot reels of magnetic tape to contain the data. Thus, a total of 20 reels of magnetic tape are required to support the quarterly processing of the CSCS historical data archive.

Two types of output products were identified: microfiche and magnetic tape in dumptape format. The microfiche output contains the 13 standard quarterly products, is printed off-line on a magnetic-tape-to-microfiche device, and currently requires 25 reels of magnetic tape. Demand products (microfiche and magnetic tape) are provided upon request. To the best of our knowledge, however, no demand products have been requested.

As can be seen by comparison with the discussions of WSSC and C-E subsystems, the CSCS subsystem has the largest output storage requirements and the largest output printing requirements. In addition, CSCS requires the largest amount of available computer system resources for processing. As far as we could determine, a detailed plan for archival storage of data base history for CSCS has not been officially established. Magnetic tape archival storage decisions must be made before we can adequately address additional storage requirements.

In summary, the CSCS subsystem will be difficult to maintain in the future, using the current processing procedures, due to the undefined requirements associated with storing the CSCS historical data base archive and with saving the microfiche magnetic tape product for backup. These two output products will require a minimum of 120 reels of magnetic tape per year, the rack space to store them, and the facility to recopy them annually to preserve on-tape data integrity. In addition, further storage difficulties are foreseen due to the undefined requirements associated with the storage of the raw feeder system data.

2.3 VAMOSC DATA BASE SIZING ESTIMATES

The magnetic tape information described in the preceding subsections was gathered to help quantify the magnitude of an integrated on-line data base that could support all of the VAMOSC subsystems. The following estimates are preliminary and, since they are based on magnetic tape storage files (where zero or blank fill is common to "pad out" a tape record and causes extra characters to be written during output), we expect them to be at the upper bound of data base size expectations. To arrive at a quantifiable data base size estimate, we made the following assumptions:

- Standard 3,600-foot reels of magnetic tape were used.
- Output was written to magnetic tape at 6,250 bits per inch (BPI), unless specifically noted.

To archive this processed information, the C-E subsystem maintains three magnetic tape files in dumptape format: the AR tape, which contains tables and factors; the AX tape, which contains cost history and comments; and the EX tape, which contains the maintenance history. Each of these dumptapes is updated annually and each contains multiple data files. The AR and EX dumptapes each reside on a single 3,600-foot reel of magnetic tape; the AX tape requires two reels.

The standard output requirements associated with printing were identified as the annual 10-page C-E O&S cost report and the annual 350-page C-E demand products report. Ad hoc report requests are processed as required and have standard output formats ranging from 1 to 3,000 pages. To the best of our knowledge, however, none of these ad hoc reports have been requested to date.

In summary, the C-E subsystem will be able to maintain future VAMOSC magnetic tape storage requirements and printing output requirements into the 1990s.

2.2.3 Current CSCS Output

The CSCS subsystem gathers, processes, and displays O&S costs by assembly/subassembly and relates those costs back to the end item or weapon system. CSCS runs quarterly to produce its printed (microfiche) output. However, it runs monthly to stay abreast of the input processing.

CSCS gathers and processes data from the following feeder systems:

Feeder	Data Description
0013	Package weight
D071	Stock list changes
D056B	WUC file maintenance
D046	NSN user change
D002A	Base consumable material transaction
D024A	Engine depot-level repair (NRTS)
D033	Depot exchangeable issue
D143F	NRTS base condemnation
D056A	Base on-equipment maintenance
D056C	Base off-equipment maintenance
G004L	Depot condemnation earned hour
G033B	Aircraft flying/possessed hours
G072D	Contractor condemnation
H036B	Depot average repair cost per labor hour
H069	Base supply and maintenance

WSSC gathers and processes data from the following feeder systems:

Feeder	Data Description
G033B	Flying/possessed hours
H069R	Accounting system for operations (ASO) cost
H069R	Depot modifications
D056A	Base manpower
D022A	Fuels and petroleum, oils, and lubricants (POL)
H036C	Depot maintenance
H036C	Replacement spares

To archive this processed information, WSSC maintains three magnetic tape files in dumptape format (one for each standard report): CAIG, Air Force detail, and Air Force detail at base levels. Each of these dumptapes is updated annually, each contains multiple data files, and each resides on a single 3,600-foot reel of magnetic tape.

The output requirements associated with printing were identified as CAIG Format Report, Air Force Detail Report, and Air Force Detail at Base Level Report. Each report has a standard format, each is distributed annually, and each is 306 pages in length.

In summary, the WSSC subsystem will be able to maintain VAMOSC magnetic tape storage requirements and printing output requirements into the 1990s.

2.2.2 Current C-E Output

The C-E subsystem gathers, processes, and displays the O&S costs that can be attributed to designated C-E equipment at the type/model/series level over the equipment's working life cycle. C-E runs annually to produce its printed output products and to update its historical archives on magnetic tape.

C-E gathers and processes data from the following feeder systems:

Feeder	Data Description
H069R	ASO cost
D039	Assets by organization
D041A	Recoverable consumption items
D056A	AFM 66-1 C-E
H036B	Depot maintenance
O013	Packaging and transportation
C003K	Mobile depot maintenance

Many interviewees were pleased with the WUC/NSN cross-reference. Inclusion of the cross-reference in VAMOSC has filled a long-standing void for Air Force cost analysts. However, the cross-reference could be improved by having contractors validate what is in the current cross-reference lists.

The last suggestion to improve system credibility is to inform the various maintenance and data processing organizations that their weapon system or SRD is being tracked. A benefit of this would be dissemination of the idea that VAMOSC is a historical repository of data. The feeder representative might suggest VAMOSC as an alternative vehicle for the same information.

2.2 CURRENT VAMOSC SYSTEM OUTPUT EVALUATION

The VAMOSC data management system currently consists of three subsystems: WSSC, C-E, and CSCS. WSSC includes a separate subsystem, VAMOH, which is a preprocessor that extracts and edits selected data from external files, both manual and automated, for the WSSC, C-E, and CSCS subsystems. VAMOH is mentioned here for completeness but will not be examined in this output analysis; however, it will play an important role in the input functional analysis that will be part of Task 2.

Each VAMOSC subsystem is a multistep, multirun job within a time-shared batch environment. Raw data or preprocessed data inputs are extracted from magnetic tape. Processing is accomplished in the computer central processing unit (CPU) with the assistance of process working files on disk storage devices and magnetic tape devices. Outputs are written to magnetic tape devices for data base storage or off-line printing. Data base tapes are written in "dumptape" format, which is machine readable and permits multiple data files of different record types to be sequenced on the same magnetic tape. The tapes written for off-line printing differ from dumptapes in that they contain records that are in printable report formats. The following subsections examine the current storage and printing output requirements associated with the magnetic tape output of each VAMOSC subsystem.

2.2.1 Current WSSC Output

The WSSC subsystem gathers, processes, and displays the total O&S costs for designated aircraft at the weapon system level (MDS). WSSC runs annually to produce its printed output products and to update its historical archives on magnetic tape.

Many people interviewed felt that the report formats could be redesigned for improved ease of use. Analysts found it difficult to locate various costs and generally found it hard to follow the flow of the report. A more columnar approach was suggested. Many interviewees felt that the VAMOSC reports were written in the terminology of a logistician and not in the terminology of their fields (e.g., communications-electronics analyst, maintenance supply analyst). They felt that the terminology should be more appropriate for the target audience.

Many cost analysts look to VAMOSC to express their needs for improved data systems and the creation of new data systems. As mentioned in Section 2.1.2.2, analysts would like appropriations to be broken out by MDS. Further, as mentioned in Section 2.1.2.3, C-E analysts would like costs computed at the LRU level. Another area for improvement is the reduction of exclusions within the feeder systems themselves. Analysts felt that a full set of cost data must be recorded and entered into VAMOSC for VAMOSC to become a credible and valuable data repository.

The creation of two new feeder systems, which could become sources for VAMOSC, was viewed as being important. Generally, users felt that data systems should be designed to collect transportation costs and software support costs.

2.1.3.2 System Credibility

The key to establishing VAMOSC system credibility is the general acceptance of VAMOSC as the Air Force standard for identifying O&S costs. Many analysts will not use VAMOSC data until other analysts have indicated their approval of the system. The consensus of those interviewed is that AFR 173-13 cost factors are the current standard. Thus, the VAMOSC Program Office should focus on satisfying the needs of AFR 173-13 analysts (AFAFC/CWM). The VAMOSC Program Office should begin to build avenues of communication with this organization and work to reduce conflicts regarding definition. This working relationship should be initiated with new weapon systems such as the F-16 and B-1B. The age of these weapon systems eliminates AFAFC/CWM's constraint for a long history of maintenance costs.

Contact should be maintained with the feeder system representatives after the data-transfer procedures have been initiated. The representatives' image of what the VAMOSC Program Office is doing with their data is important. Since many analysts still use feeder data directly, the feeder system representatives can communicate their satisfaction or dissatisfaction with VAMOSC's use of their data. The VAMOSC Program Office should check with the feeder system personnel to ensure receipt of a complete set of data. The VAMOSC Program Office should also investigate the feeder system representatives' satisfaction with the extraction and use of key data elements for cost computation. The VAMOSC Program Office should be informed of any changes regarding data elements or algorithms, as well as interface modifications.

area targeted for improvement should be data element definitions. VAMOSC should have correct and explicit definitions that allow primary users to manipulate data as reported or to sum to the level desired. The definitions should be exact so as to avoid data overlaps or conflicts between feeder systems and VAMOSC. One very good tool commonly used is the data element dictionary (DED). DEDs are not easily constructed but are very effective, especially in situations such as VAMOSC where the same feeder system supplies similar (if not identical) data. VAMOSC has its own form of a DED, but for the subsystems only.

Consistency of data between data sources is also important. Inflation factors resident in feeder system data should be recognized and removed before VAMOSC costs are calculated. Contractor-recorded data are currently not reported in the same format as U.S. Government maintenance data.

Many analysts said that a common data base should exist for WSSC and CSCS. Many potential users attempted to relate WSSC dollars to CSCS dollars without success. They acknowledged reading a statement in AFR 400-31 that the sum of CSCS data elements will not equal WSSC data elements. However, it seemed logical to them that if both VAMOSC subsystems costed the same weapon systems, the numbers from one subsystem should add up to those of the other subsystem. If WSSC and CSCS had a common data base, the analyst could be certain the two subsystems had the same data elements. (This area is to be considered in Task 2 as a sizing event for system architectures for the 1990s and beyond.)

Many current and potential users were confused by what they termed an "excessive number" of zeros in the various reports. There was a question as to if they were actually zero values or if the data were not available. A solution would be to maintain a consistent policy for all VAMOSC reports, requiring asterisks to denote that no data were available. A "0" would indicate that no dollars were expended.

As VAMOSC matures, it becomes increasingly important to maintain audit trails to account for any changes in the data. An audit trail should be maintained for the VAMOSC cost allocation logic history, which would track all VAMOSC algorithm changes. A system event history should be maintained as well, containing changes to the maintenance and documentation environment. Variances tracked should include maintenance policy changes, major equipment modifications, feeder system changes (exceptions and definitions), WUC/NSN changes, and data element changes.

One of the main assets of VAMOSC is that operation and support costs, reported by the many data systems, are combined into one report. The report provides for easy access, which was unavailable before VAMOSC and its predecessors. However, cost analysts typically need cost drivers when statistically analyzing the costs. VAMOSC provides such statistics as aircraft flying hours and inventory. However, requests for additional cost statistics included low-cycle fatigue counts, depot overhaul rates, number of failures and other events, and mission differences. Inclusion of these drivers would enhance VAMOSC's "stand-alone" capability.

About a month before our interviews, LME Corporation visited both HQ AFCC and SM-ALC/MMC and displayed its latest C-E logistics support cost management (LSCM) reports. Organizations that we subsequently interviewed expressed concern about duplication of effort and wanted LME's data to be incorporated into VAMOSC.

Overall, most C-E analysts interviewed felt that VAMOSC has authority and the potential to stimulate directives for the capture of C-E data currently not reported. They believed that for VAMOSC to be a credible data repository, a full set of cost data must be recorded and entered into the VAMOSC system. The analysts felt that the VAMOSC office should make Air Staff aware of the lack of proper C-E cost data.

2.1.2.4 Potential CSCS Requirements

All of the contractors interviewed, as well as AFAFC/CWM, responded that summarizations to the two- and three-digit work unit code (WUC) levels were necessary CSCS requirements. The contractors showed us the Navy VAMOSC WUC breakout, in which each summary level is presented on a separate page. They felt that this type of WUC breakout might be considered for use in VAMOSC's product. An annual report incorporating the four quarters of CSCS data could also be considered.

After investigating VAMOSC's 1982 depot maintenance data, current and potential users found several unexplained gaps. They concluded that sections of H036 data were not properly allocated. Cost analysts expressed the need for a summary of dollars per aircraft by EEIC and dollars per flying hour by EEIC.

Not-repairable-this-station (NRTS) tracking is another area in which analysts (specifically those of AFAFC/CWM) expressed interest. They would like the originating MAJCOM or base, the specific WUC, and the final disposition to be indicated for each NRTS.

2.1.3 Suggestions for Improvement

When ARINC Research compiled the analysts' requirements, many suggestions for improving the current VAMOSC system became evident. They should be considered, because they are representative of concerns of the VAMOSC user community and can only be applied at the system level. The suggestions can be grouped into two categories:

- Improving the overall validity of data
- Establishing credibility of the VAMOSC system

The suggestions are evaluated in the following subsections.

2.1.3.1 Data Improvement

Now that the three VAMOSC subsystems have become operational, attention should be focused on ways to improve the data. Current cost data breakouts and the general scope of VAMOSC should be reviewed. The first

AFAFC/CWM required that the weapons system cost retrieval system (WSCRS) breakout of data be carried over in the WSSC report. Some of the known formats include airframe overhaul, engine overhaul, engine accessories, black boxes, contractor logistics support (CLS), interim contractor support (ICS), and modification maintenance.

2.1.2.3 Potential C-E Requirements

The C-E requirements focused on the accuracy of feeder data and thus the accuracy of VAMOSC data. C-E requirements covered a broad area.

The greatest concern expressed was the high percentage of C-E maintenance that cannot be documented because a standard reporting designator (SRD) has not been assigned to many components of C-E equipment. It is difficult to track consumables such as resistors and wire to a specific end item, since C-E has a small inventory of end items spread over 500 locations throughout the Air Force. As a result, costs of bench stock consumables are not recorded. This presents a large problem for C-E cost analysts (one commented that 50 percent of the C-E supply cost is consumables).

Many C-E users expressed a requirement that all labor and cost data be captured and included in VAMOSC. VAMOSC could capture consumable costs as well as maintenance man-hours that are currently viewed as overhead. It was noted that analysts rely on these data and are currently required either to go back to what are now VAMOSC feeder systems or to estimate (usually the latter).

One specific C-E cost documentation requirement was provided by HQ AFCC, a tenant organization. HQ AFCC is supported by a MAJCOM's assets, and that command pays the majority of costs. HQ AFCC must rely on the host's data systems for recording C-E maintenance and supply costs.

HQ AFCC/EPCRI requested that a unique SRD be assigned for premobile survey and mobile depot maintenance. This would allow for the separation of premobile and depot maintenance from other C-E maintenance recorded in the D056 data system. It would also eliminate the need for the C003K data system, which HQ AFCC/EPCRI currently provides to the VAMOSC Program Office.

C-E analysts required accurately recorded travel costs associated with repairing a small number of components spread throughout the country. C-E analysts would be more comfortable using these data if a validation process were undertaken. Validation would also inform the organizations that the TDY costs were being tracked by VAMOSC, and it might stimulate more accurate data recording.

C-E analysts said that costs should be computed on a more detailed level than type/model/series; the line-replaceable unit (LRU) level would provide for better analyses. C-E users would also like to see discrete hours reported for preventive maintenance inspection (PMI) rather than job standard hours.

TABLE 2-3

POTENTIAL GENERIC REQUIREMENTS

System Characteristic	Requirement	Comments
Historical Data Storage	Minimum: from 1 to 10 years; maximum: from 5 years to lifetime of years of weapon system	Most common responses: 5 years minimum, 10 years maximum
Data Age	Fiscal year-end data	
Frequency of Data Reuse	First-time requests for new data: 2 to 3 per month; repeated access of on-hand data: once per week	Not much information is available on actual VAMOSC usage
Response Time	1 day to 1 week	Most common response time is currently up to a month
Output Product Media	Majority of users: magnetic tape data files; other users: microfiche and paper	

O&S costs listed by program element were also required. One analyst required the separation of modification man-hours from maintenance man-hours.

AFAFC/CWM expressed a desire for Integrated Appropriation Accounting and Program Status (H058) data, which provide information for those costs which otherwise are not currently tracked. However, dollars authorized to a mission/design/series (MDS) are usually distorted by the predominancy rule, which assigns all of a base's appropriations to the MDS having the most aircraft, if that base has more than one weapon system. For the H058 data to be beneficial, the predominancy rule would have to be circumvented, and the appropriations would have to be separated by individual MDS.

APPENDIX A

VAMOSC USER SURVEY

This appendix presents the form used in our VAMOSC survey of cost analysts.

VAMOSC USER SURVEY

DATE: _____

1. Name: _____

   Organization: _____

2. Job Description: _____

3. What exposure have you had to VAMOSC? _____

4. What data are used to perform the analysis? Which reports, for what type of data? _____

5. Are they standard reports or special requests? _____

6. If VAMOSC is used, do you supplement it with other data? What data? _____

7. If VAMOSC is not used, are you aware of data available from VAMOSC?

8. Do you use the WUC/NSN cross-reference? How can this be improved?

9. What is the typical range of data required? (3 years, 5 years, 10 years, more than 10 years) _____

10. Is having current data important? _____

11. What was the response time for your initial requests? _____

    Subsequent requests? _____

12. What is the maximum response time allowed? _____

13. What would be the effect on usage if the system was on-line?

14. How frequently do you request data?

Are they recurring requests, or do you require special reports for different aircraft/components, depending on the type of study required?

15. What do the data look like?

- Physical characteristics: magnetic tape, fiche, paper reports

- Memory required: number of bytes, number of pages of paper

16. Are data entered into the model manually or read in automatically?

17. What machine is your analysis performed on?

18. What models and techniques do you use to analyze data?

19. What data elements are used? Do you do much processing on the data, or can you plug them directly into your algorithms?

20. Do you recommend adding other data elements?

21. What is your overall impression of VAMOSC?

APPENDIX B

PERSONNEL INTERVIEWED

As part of the Task 1 effort, ARINC Research conducted a survey to identify VAMOSC users and potential users and to gather their comments and suggestions concerning the continued growth of the system. The following list includes all of the survey participants and the applicable VAMOSC subsystem.

Wright Patterson AFB, Dayton, Ohio

HQ AFLC/ACMCE	S. Klipfel, B. Wysinski	WSSC
HQ AFLC/ACMCI	R. Steinlage	WSSC
ASD/XPLI	Lt. M. Ingrahm	CSCS
AFWAL/FIA	Dr. N. Sternberger, Lt. Rush	CSCS
VAMOSC	R. Pettigrew	WSSC
	J. Lykins	C-E
	N. Prince	CSCS

Scott AFB, St. Louis, Missouri

HQ AFCC/LG	Mr. Teeter	C-E
HQ AFCC/LGMMA	Lt. P. Leix	C-E
HQ AFCC/EPC	W. Chapman, E. Connors	C-E
HQ AFCC/LGSO	Maj. Decker, Lt. C. Niemaber	C-E
HQ AFCC/LGSSS	M. Pecoraro	C-E
HQ AFCC/ACMC	Lt. Col. Daigler, B. Vaughn	C-E
HQ MAC/LGXA	Capt. Lamaier, Chief MSFT Whitelock	CSCS

OC-ALC, Oklahoma City, Oklahoma

	G. McNeil, A. Ritter	CSCS

McClellan AFB, Sacramento, California

SM-ALC/MMC	Col. G. Monahan, L. Pursell	C-E
SM-ALC/MMCRA	E. Gedney, P. Ventolieri, F. Libby, K. Herzberg, G. Ray, E. Wickenberg	C-E
SM-ALC/MMCRS	R. Galloway	C-E
SM-ALC/MMCE	Col. D. Goddard, E. Anderson	C-E
SM-ALC/MMEA	G. Coleman	CSCS, C-E

Lowry AFB, Denver, Colorado

AFAFC/CWM	Lt. Col. L. Takamura, Maj. Bradney, Capt. J. Grater, Capt. P. Larson, B. Forgie, Capt. B. Draper	WSSC, CSCS

Pentagon, Arlington, Virginia

HQ USAF/LEYM	J. Janesieski	
HQ USAF/LEYE	W. Carter	C-E
HQ USAF/ACMC	Lt. Col. D. Owen	WSSC, CSCS
OSD/PA&E	Lt. Col. B. Beckner	
OSD/PA&E	Lt. Col. D. Devers, D. Pombrio	

Andrews AFB, Camp Spring, Maryland

HQ AFSC/ALPA	J. Rosso	

Boeing Aerospace Co., Seattle, Washington

	F. Crosetto, L. Witansky, A. Olesberg, G. Herrold, D. Wilson, R. Parks	WSSC, CSCS

Northrop Aircraft Division, Hawthorne, California

	P. Gerrard, F. Heyer, M. McCarthy, L. Donaldson, N. Chang, A. Tyszkiewicz	WSSC, CSCS

Lockheed California Company, Burbank, California

	J. Daniledes, D. Horning, M. Guess	WSSC, CSCS

Rockwell International, Los Angeles, California

	B. Morris	CSCS

Information Spectrum, Inc., Arlington, Virginia

	A. Frager	WSSC, CSCS

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REPORT DOCUMENTATION PAGE

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This letter report, which describes the results of Task 1 activity, is submitted in accordance with Contract Data Requirements List (CDRL) Sequence Number A002 of Contract F41608-82-D-A012-0005. The report documents the first phase in recommending a cost-effective technology that will support the data requirements of the U.S. Air Force Visibility and Management of Operating and Support Costs (VAMOSC) for the 1990s and beyond. Such a technology will allow VAMOSC to become more timely in its response

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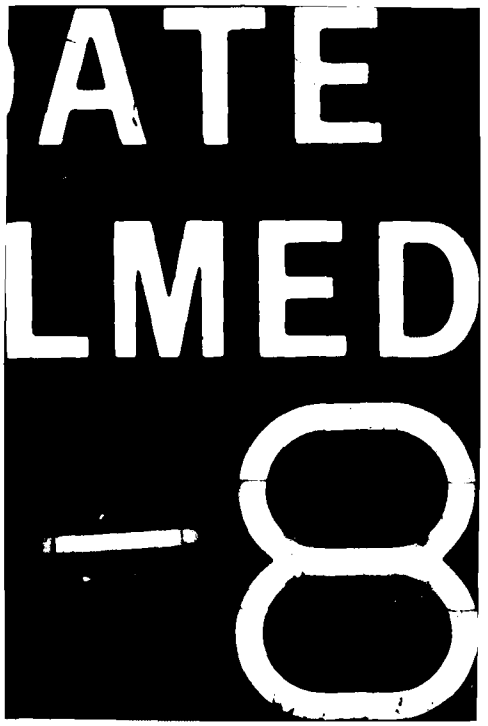
20. to the needs of VAMOSC users as processing demand are imposed by future growth. Task 1 consisted of identifying the current and future data requirements. The period of performance for this task was 1 October 1983 to 1 March 1984.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